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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/819,762	03/29/2001	Yoshiki Sakuma	010401	2685

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EXAMINER

BAUMEISTER, BRADLEY W

ART UNIT PAPER NUMBER

2815

DATE MAILED: 10/09/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.  
**09/819,762**

Applicant(s)  
**Sakuma et al.**

Examiner  
**B. William Baumeister**

Art Unit  
**2815**



-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on Aug 5, 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-18 is/are pending in the application.
- 4a) Of the above, claim(s) 3 and 12-18 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 2, and 4-11 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claims \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some\* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\*See the attached detailed Office action for a list of the certified copies not received.

- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                              | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)          | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____ | 6) <input type="checkbox"/> Other:  |

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## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 2 and 4-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa '614 in view of Applicant's Admitted Prior Art.

- a. Furukawa '614 (supplied in IDS #3) teaches that C can be added to SiGe in a Ge:C constant-ratio range of about 6.7/1 to 12/1 (e.g., claim 1) for Si concentrations ranging from about 90% to 0 % (e.g., col. 7, lines 50-54) for the purpose of reducing the lattice strain between SiGe/Si heterointerfaces and thereby inhibiting resultant lattice defects. Furukawa specifically teaches that this concept may be employed for Group IV HBT formed on a Si substrate having a SiGeC base and that the resultant base bandgap is smaller than that of the Si emitter and collector (e.g., col. 5 and FIG 4). Furukawa does not teach grading the Ge content of the SiGeC base.

- b. Applicant acknowledges that it was known to grade the SiGe base region of an HBT with constantly increasing Ge content in the direction of the collector for the purpose of accelerating electrons traveling through the base for the purpose of increasing the device's

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operational speed. (See prior art FIGs 1A/B and the BACKGROUND OF THE INVENTION section of the specification, particularly page 3.) It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed a conventional, graded SiGe base as acknowledged by Applicant in the HBT of Furukawa for the purpose of increasing the device's operational speed.

3. Claims 1, 2 and 4-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP '834 in view of Furukawa '614 as applied to the claims above.

a. JP '834 (supplied in IDS #3) discloses Si-based HBTs formed on a Si substrate wherein Ge is alloyed with the Si in the emitter, base and collector regions for the purpose of decreasing the lattice misfit of the regions (Abstract and FIGs). The Ge content continuously increases in the base layer in the direction of the collector and has a non-zero Ge composition at the emitter interface of the base. JP '834 does not teach employing SiGeC alloys.

b. As explained above, Furukawa teaches the use of SiGeC alloys in various devices including HBTs for the purpose of reducing lattice strain. It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed SiGeC instead of SiGe in the JP '834 HBT for the purpose of further reducing the device's lattice strain and increasing the degree of design freedom in adjusting the various region's bandgaps as desired.

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*Response to Arguments*

4. Applicant's arguments filed 8/5/2002 have been fully considered but they are either not persuasive or moot.

a. Applicant has argued that Furukawa does not teach providing a C concentration gradient in the base layer of an HBT. The Examiner agrees that Furukawa does not teach this in itself. However, as was explained, Furukawa teaches that in order to maintain SiGeC lattice-matched with Si, the Ge:C ratio of the SiGeC needs to be maintained at approximately a constant ratio. As such, when an HBT is formed according to the prior art such that the Ge content is graded, and when C is added to the SiGe base for better lattice-matching as taught by Furukawa, Furukawa further teaches that the C content must also be graded proportionally with the Ge in order to maintain the proper Ge:C ratio and hence the lattice match condition.

b. Applicant has argued that JP '834 teaches a C gradient that is just opposite to the gradient set forth in claim 1. Claim 1 sets forth that the C increases from the emitter to the collector. The Examiner notes that JP '834 was not relied upon for the teachings of FIG 2 wherein C is added to the emitter to increase the emitter's valence band energy and associated band gap. Rather, the Examiner was relying on those teachings of JP '834 that set forth a graded Ge base wherein the Ge increases from the emitter to the collector (e.g., FIG 1b). As such, the rejection was and is based on combining JP '834, teaching the increasing Ge content in the direction claimed, with Furukawa for the proposition that the SiGe base can be better lattice matched to Si by offsetting the Ge concentration with an appropriate, corresponding amount of C

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which must be directly proportional to the Ge concentration. As such the C concentration must also increase in the direction claimed in order to maintain the lattice match.

c. Applicant has argued that none of the references teach including C in either of the emitter or collector region. This is not found persuasive because JP '834 teaches HBTs wherein Ge extends into the emitter and collector (e.g., FIG 1b: Ge is present in the n-doped regions). Under the rationale set forth above, since C may be added to those regions that include Ge for better lattice-matching, it would have been obvious to also include the appropriate proportions of C in those portions of the emitter and collector that possess Ge to maintain this lattice match.

d. The arguments relating to claim 3 are moot because claim 3 is directed towards a non-elected invention, and no generic claims are allowable for the reasons set forth hereinabove.

### *Conclusion*

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however,

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will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.


**INFORMATION ON HOW TO CONTACT THE USPTO**

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister**, at **(703) 306-9165**. The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Eddie Lee, can be reached at (703) 308-1690. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

B. William Baumeister

Patent Examiner, Art Unit 2815

October 7, 2002



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